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A REVIEW ARTICLE ON ARTIFICIAL INTELLIGENCE IN TRADITIONAL MEDICINE RESEARCH AND APPLICATION

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Abstract: The integration of artificial intelligence (AI)) into traditional medicine research marks a significant shift in how these ancient practices are studied validated and applied in the modern era this provides a comprehensive analysis of the current state of AI application across various traditional medicine systems including Ayurveda, siddha ,Unani and traditional Chinese medicine (TCM) the use of AI technologies such as machine learning, deep learning and natural language processing is revolutionizing traditional diagnostic techniques enhancing accuracy and personalization of treatments and advancing herbal medicine research. In diagnostic AI is improving the precision of traditional methods like pulse diagnosis, which is central to systems like ayurveda and siddha, by using sensor data and machine learning algorithms to analyze subtle physiological variations. AI also supports the personalization of treatments by integrating genomic data with traditional medical principles, leading to more effective and individualized healthcare solutions. Additionally, AI driven research in facilitating the discovery and optimization of bioactive compounds in traditional herbs, accelerating the development of new, scientifically validated therapeutical options. Despite these advancements the integration of AI into traditional medicine poses several challenges, including need for culturally sensitive approaches, the risk of oversimplifying complex traditional concepts, and the development of appropriate regulatory frameworks to ensure safety and efficacy.

Keywords: Artificial intelligence, Ayurveda, Siddha, Unani, Traditional Chinese Medicine, Machine learning, Deep learning, Diagnosis, Bioactive compounds, Safety and Efficiency, Challenges.

1. INTRODUCTION

Traditional medicine including systems like ayurveda siddha Unani and traditional Chinese medicine (TCM) has been integral to healthcare for centuries relying on natural remedies holistic approaches time honored diagnostic technique. These systems while deeply rooted in cultural heritage and philosophical principles often lack the empirical validation required by modern scientific standards. The advent of artificial intelligence (AI) is transforming this landscape offering powerful tools to analyze and interpret vast amounts of traditional knowledge refine diagnostic accuracy and develop more effective treatment protocols. AI encompasses a variety of technologies including machine learning, deep learning, natural language processing (NLP) and data analytics which are increasingly being applied to enhance tradition medicine practices. These technologies can process complex data sets identify pattern and generate insights that were previously beyond the reach of human capability. For example machine learning and algorithms can analyze patient data to improve the precision of traditional diagnostic methods such as pulse diagnosis in ayurveda or siddha while NLP can mine ancient texts for valuable medicinal knowledge.

More over AI is playing a crucial role in herbal medicine research traditional system often utilize complex formulation made from various herbs and minerals AI models can analyze the chemical properties of these ingredients predict their therapeutic effects and even suggests new combination that enhances efficacy or reduce side effects. This integration of AI not only modernizes traditional medicine but also helps in global acceptance and scientific validation of these ancient practices. [1]

1.1 New ways to analyze data, enhance diagnostics and optimize treatment methods by using AI in traditional medicine research

1.1.1 Data Analysis and Integration

Big Data Handling

AI can analyze huge Bank of knowledge derived from TCM and Ayurveda and other ancient medical systems. These data comprise pharmacopoeia formulations of herbs, efficacy, and treatment profiles of patients. Machine learning (ML) methods can find similarities and differences, which will assist the researchers to find correlations between treatments and effects.

Omics Integration

AI as a tool connects genomic, proteomic, and metabolomic data with traditional approaches to healthcare. This increases the knowledge of pharmacodynamics in relation to natural products.

1.1.2 Drugs Discovery and Development

Natural Product Analysis

AI can help identify bioactive compounds in plant, herb, and other related natural products traditionally used in traditional pharmacopoeia. Algorithms make an attempt to provide an insight to the possible effectiveness of these compounds and their utilization in the contemporary formulations.

Predictive Modeling

Machine learning tools can forecast how current Chinese herbal recipes impact bio systems and therefore traditional medicine could contain fresh drugs sources, although there is few data proving this theory.

1.1.3 Personalized Medicine

Tailored Treatments

Thus, tied to the principles of traditional medicine, AI can diagnose an individual patient and determine his treatment depending on genetic and environmental predispositions as well as the patient's lifestyle. It also makes it possible for interventions to be more accurate when combining AI with the older techniques.

Patient Monitoring

Smart wearable's and health app based on AI make continuous surveillance of patients applying conventional treatments possible and provide recommendations for changing the treatment outcomes.

1.1.4 Diagnostics Enhancement

AI concerns were identified as involved in the assessment of patient symptoms and biometrics to diagnose diseases utilizing the conventional medical models. For instance, in TCM technologies based on AI are being created for pattern recognition of tongue image and pulse data to enhance precise diagnosis. AI can help especially when it comes to implementing conventional diagnostic methods for chronic diseases, it might detect symptoms that are minute and could be easily overlooked by a human-being.

1.1.5 Bridging Traditional and Modern Medicine

Knowledge Translation

AI can act as an interlocutor between traditional and modern medicine, which transcribes the experience accumulated over centuries into languages understood in the context of contemporary research. Information which can be obtained by NLP from old texts includes important information that is involved in the modern world of healthcare.

Validation of Traditional Practices

Consequently, using established methods of artificial intelligence, conventional wisdom in medicine can be corroborated, and thus buttressing traditional forms and practices of healing is increasingly being accepted in modern institutions.

1.1.6 Clinical Decision Support

AI-assisted Diagnosis

Decision support systems aided by the artificial intelligence assist the traditional medicine practitioners to arrive at a better decision through advising the practitioners on the merit of the previous practices, the patient-essential history, and accepted treatment solutions.

Treatment Optimization: AI can fine-tune conventional treatment plans, making practitioners tweak herb ratios or acupressure points according to a mountain of results from previous patients.

1.1.7 Challenges and ethical issues

Cultural Sensitivity: AI in traditional medicine should consider the cultural aspect and practices because the use of these techniques is an art form part of a patient's healing process.

Data Quality and Standardization: AI is still unable to make sense of traditional medicine records as there is no standardized structure for this kind of data. It becomes necessary to compile all-round databases and standard for maintaining data for appropriate AI implementation.

Patient Privacy: Like any AI in any field, and more so when it comes to using and collecting patient data in healthcare there are issues of ethicality especially when utilizing the patient's history with the conventional practices. [2]

2. Artificial intelligence in traditional medicine research and application in diseases

2.1 Malaria

AI especially in traditional medicine for malaria research has also shown remarkable advancement mainly by integrating the wealth of information on herbs and traditional knowledge with advanced machine learning technologies in the fight against malaria. Here's a deeper drive into various aspects:

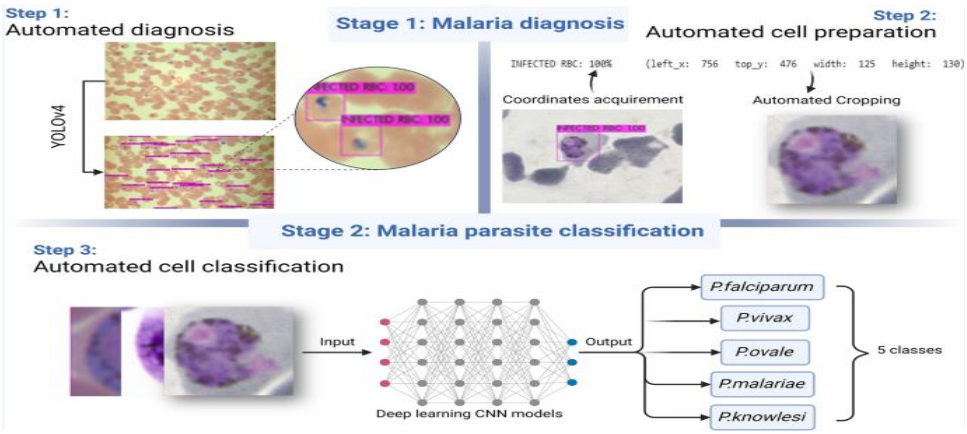

Figure 1: The malaria diagnosis and malaria parasite classification

2.1.1 Artificial Intelligence in Drug Discovery from Traditional Medicine

From the traditional source, QSAR like Quantitative Structure – Activity Relationship has been instrumental in the identification of malaria combating compounds. These models illustrate molecular patterns of plant chemical components including alkaloids, flavonoids, and terpenoids that hold antimalarial healing attributes. [3] Assessing these compound's chemical characteristics, AI can estimate if they can be effective against malaria parasites such as Plasmodium falciparum. For example: AI has played a role in studying Artemisia annua, a plant that has been used traditionally in China for cure of malaria that yielded to artemisinin a potent malaria killing Venus. Since AI hastens the procedure of removing inactive compounds and determining their modes of action against the malaria pathogens. [4]

2.1.2 Prediction of Active Ingredients and Therapeutic Target

Molecular interaction between active ingredients of TCM and molecular targets in the malaria parasite can be predicted with the help of AI powered systems. These systems assist in determining how these traditional remedies function at the molecular level through the unbundling of the large biological datasets. On these datasets, deep learning algorithms including Convolution Neural Networks (CNNs) and Graph Neural Networks (GNNs) are used to forecast the pharmacological impacts of natural compounds in traditional medicine. [5]

2.1.3. Optimization of an herbal combination

Traditional medicine is always in blended format or mixture of herbs and very scarcely single herbs are used. AI can therefore examine such mixtures and estimate how different blends might simultaneously perform in curing malaria. This is most helpful in systematical use of numerous herbs at one time as is the case with Ayurveda and Traditional Chinese Medicine (TCM). Current AI algorithms are also being used to train these interactions making it possible to enhance the combinations of these herbs in order to fight malaria. [6]

2.1.4. Network Pharmacology

Network pharmacology is another area of AI assistance, signifying acknowledgement of multiple targets and pathways controlled by one orthodox substance. Most beneficially, in malaria, it can display the chemical structures of the plant-derived antimalarial compounds, illustrating which parts would not mesh with the various segments of bioactive molecules to serve the multiple ends. Network Analysis help in identifying the specific herbal compounds that may have immunosuppressive activity or interfere with the parasite's life cycle, in one or other stage. [7]

2.1.5. Challenges in AI Integration

Data Quality: To improve the AI model for the identification of Traditional remedies more refinements are required: Quality and low variance of efficacy, and composition of Traditional Chinese medicines.

Biological Complexity: This is because traditional medicine usually has multiple active compounds, which makes the work of AI algorithms complicated.

Validation: Yet, their predictive models have to be relied on experiments carried out in laboratories as well as clinical trials. [8]

2.2 Lung Cancer

Significant changes have taken place in the trends of artificial intelligence in traditional medicine research and its development and applications in inherently difficult diseases including lung cancer. AI can combine the knowledge acquired through thousands of years of using medicine in traditional medicine processes to enhance contemporary approaches to lung cancer. The following are the AI influencing this field:

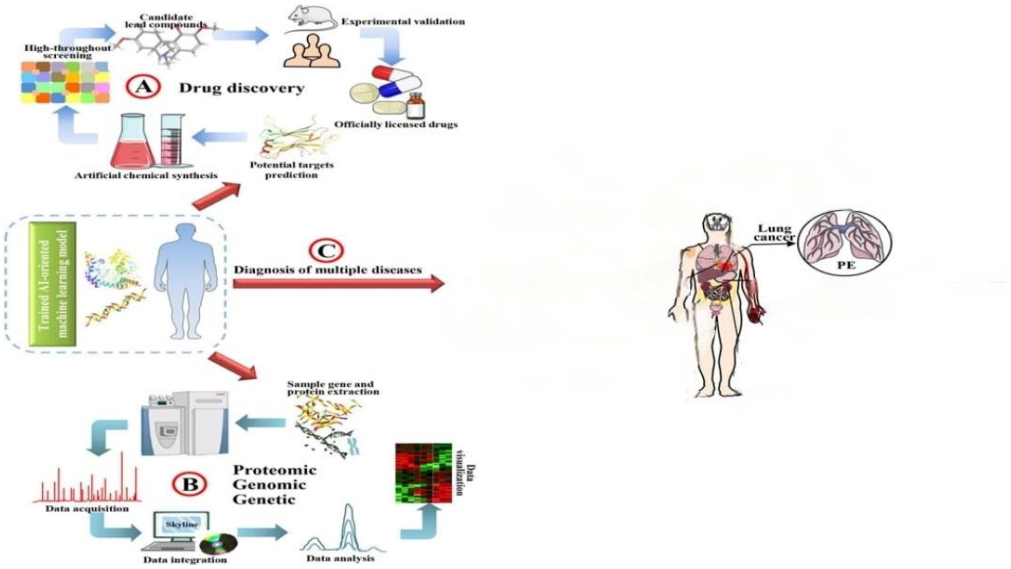

Figure 2: AI in drug discovery and diagnosis for lung cancer

2.2.1 Identifying Active Compounds in Traditional Medicine

Advanced algorithms of AI in particular can scan various databases of herbal compounds in order to detect possible anti-cancer agents. Many herbs used in Ayurveda and other forms of traditional medicine including TCM are claimed to have cancer fighting capabilities, such proof is however limited. AI models, including machine learning and neural networks, can predict the efficacy of these herbs based on molecular structure and biological pathways involved in cancer proliferation. For lung cancer: TCM Herbs like Scutellaria baicalensis, Astragalus and Ganoderma Lucidum. This category of herbs strengthens the immune system and slows the growth of tumors; through clinical and historical data analysis AI can determine the effectiveness of these herbs in treating lung cancer. Ayurvedic Herbs such as Ashwagandha, Curcuma longa (Turmeric). These herbs possess properties of anti-inflammation and anti-tumor; AI can find the effectiveness of these herbs in lung cancer cells.

2.2.2 Personalized Medicine

Informed strategies performative through the AI can use methodologies of traditional medicine bearing in mind genetic, environmental and lifestyle variations. AI is capable of recommending the right traditional herbal remedies that match genetically a certain patient for treatment or management of lung cancer.

Genomic Analysis

It can also pinpoint which type of traditional herbs may be optimally effective for different genetic subtypes of lung cancer through the help of artificial intelligence genomic study. For instance, clients with specific genetic characteristics may reap more gains from the like of Ginseng or Astragalus since the former can boost vigor and other phytochemicals within the lungs that are associated to lung cancer. [9]

2.2 3 AI-Enhanced Clinical Trials

AI can enhance clinical trials concerning traditional medication and lung cancer and fasten the research in addition to enhancing the safety. AI solutions can choose a trial for a patient, predict possible complications in a combination of the traditional treatment and CAM, and define who will benefit from it most. AI can predict how different traditional medicines will affect lung cancer cells, and guide researchers to the best treatments. This can spare time and cost to the drug producing company since only effective treatments are researched further before been tested on human beings.

2.2.4 Diagnosis and Early Detection

Lung cancer diagnosis can also be improved significantly through the use of enhanced AI tools which can work in partnership with other techniques used in the diagnosis of the disease. For instance

Pulse Diagnosis in Ayurveda

Pulse data go hand in hand with the other biomarkers so, AI can identify the early indications of lung cancer.

Tongue and Facial Diagnosis in TCM

Experimental results show that using tones of voice and facial and tongue movements AI systems can be trained to look for hints of body imbalances that are associated with the preliminary stages of lung cancer. [10]

2.2.5 Combining Traditional with Modern Treatments

Artificial intelligence can help make informed decisions on how traditional medicine is to be combined with modern treatments of cancer. It can determine the compatibility of herbs and chemotherapy, radiation or immunotherapy, finding which combination gives the toxicology effect and the best results. Instead of the common treatment that include Chemotherapy for lung cancer, AI can suggest herbs like Ginger or Licorice that have been used historical to help cure nausea and inflammation which are side effects of chemotherapy.[10]

2.2.6 Preventive Medicine

AI applications can also create demand for traditional medicine in prevention and control disease. In the area of lung cancer, AI can predict herbal medicine that might be beneficial for a given user depending on his/her risk factors and recommend lifestyle modifications and diets necessary for a given user. [11]

2.2.7 AI Applications in Lung Cancer Research

TCM Approach

AI can improve the accurate diagnosis and prescription of TCM herbs and acupuncture, moxibustion therapy, and thereby improve lung cancer treatment. For instance, it is possible to compare the results of the use of a combination of

herbs such as 'Cordyceps' and 'Scutellaria" in mitigating tumor size and enhancing the experiences of the patients.

Ayurveda Approach

The AI tools can help patient's doshas (one or more body constitutions) and recommend treatments using herbs like "Tulsi" and "Pippali" to address lung function and immune cancer patient responses. [12]

2.3 Influenza A virus

with focus on traditional medicine, a couple of investigations have been performed on the integration of artificial intelligence for Isatis tinctoria against influenza A virus. Isatis tinctoria commonly identified as woad is one of the plants recognized across the nations, globally for its traditional uses when it comes to diseases characterized by infections and/or inflammation of tissues.

2.3.1 Data Mining and Analysis

By big data analysis of the data derived from traditional source of medicine, AI's algorithms can discover the potent antiviral compounds found in Isatis tinctoria. [13] Machine learning can forecast the virtuous of these compounds against or Influenza A based on the chemical structure and the previous biological activity.

2.3.2 Network Pharmacology

AI is used to build more complex interaction networks explaining how Isatis tinctoria compounds work on different viral proteins. These maps could also map potential antiviral approaches such as the inhibition of viral enzymes or viral receptors and give a systemic view of how the compounds isolated from woad might interfere with the life cycle of the Influenza A virus. Applying artificial molecular docking, scientists estimate the binding constants of chemical molecules such as indirubin and isatin with Influenza A proteins that can be the first step toward the assessment of efficiency.

2.3.3 Predictive Modeling

Using an AI outcome prediction approach, the researchers are able to deduce how Isatis tinctoria affects any of the distinct Influenza A subtypes. Such simulations are fragments of viral genes with the use of the selective approach to assess the efficacy of the compound with reference to various mutations of the virus. By mathematical computation, AI models determine the probability of the distribution of Isatis tinctoria compounds with give dosages in tissues, organ systems to give possible therapeutic dosing curves. [14]

2.3.4 Clinical Trials Optimization

AI systems are complexes which may take advantage of genetic and demographic information as to clinical trial samples, and determine likely patient populations to respond to Isatis tinctoria treatment. AI also complements current antiviral drugs by determining complementary interactions of Isatis tinctoria constituents in order to establish more effective clinical trial designs. [15]

2.3.5 Key Findings from Research

Active Compounds

several studies demonstrated that indirubin, isatin, and many other derivatives of Isatis tinctoria possess strong antiviral effects. These compounds are believed to have an antiviral effect through interaction with the virus at different levels such as entry and replication. [16]

Mechanisms of Action

AI-enabled biochemical assays also predict that these compounds might prevent viral entry by interacting with host cell receptors or might hinder replication by interfering with such vital viral proteins as RNA polymerase. [17]

Synergistic Effects

Due to resource constraints, systematic studies have not been carried out into the conditions under which Istatis tinctoria can be combined with other herbal medicines. AI models, however, suggest that other herbal medicines, combined with Istatis tinctoria, may have synergistic effects which improve the efficiency of the antiviral.

2.3.6 Challenges and Future Directions

Data Quality and Availability: Availability of quality data is very essential for good AI modeling to take place.

Integration with Modern Medicine: Overcoming the division between conventional approaches to knitting and its clinical use in today's world with the help of AI solutions is still a complex task.

Clinical Validation: For this reason, Isatis tinctoria compounds' safety and efficacy must be tested for different populaces as well as exemplified across various viral strains through the completion of extensive trials.

Ethical Considerations: Since AI is applied to medicine, it has to follow ethics, including those on traditional knowledge. [18]

2.4 Rheumatoid Arthritis

These technologies have demonstrated unique ability to diagnose various diseases, make effective decisions and increase patient prognosis. In one special category of diseases that have been known to cause chronic inflammation, artificial intelligence shows potential for changing the diagnosis and prognosis of rheumatoid arthritis (RA). Cloud computing together with artificial deep learning algorithms provides solutions on large scale medical data and improves the research and surge clinical enhancements.

2.4.1 Deep Learning in Medicine

Machine learning, in its turn, encompasses various techniques, one of which is called deep learning, which missionizes to mimic the structure of the human brain and learn patterns from big data. In the medical field, deep learning has been found useful in incurred functions like diagnosis of images, electronic health record (EHR) and prognosis analysis. Given their capabilities to recognize abnormal patterns in images such as X-rays, MRIs and CT, these systems can be used in diagnosis of diseases including cancers, heart diseases and RA. Convolution Neural Networks (CNNs) models have been the most employed in analyzing medical images in deep learning systems. In RA, deep learning models have been applied for the identification of joint erosions and inflammation in order to initiate early intervention. [19] Deep learning can extract structured and unstructured data from EHRs to screen and predict risk factors, disease progression, and the patient's future prognoses. [20]

2.4.2 Cloud Computing in Medicine

Cloud computing offers the requirements for the storage, management, as well as analysis of big data as created in

the health industry. They can aid physicians and researchers to connect to patient records, computational resources, and models, respectively from distance and in real time.

Scalability

Infrastructure as a service, storage as a service, computation as a service, databases provided through Google cloud, AWS, and Microsoft Azure are versatile, to support the processing of large volumes of data from medical image and genomics processing as well as data from wearable's. This is especially important in diseases like RA that require follow up cases on large populations over long time durations.[21]

2.4.3 The utilization of AI in Diagnostic Rheumatoid Arthritis

We found that AI, especially deep learning, could help enhance diagnosis of RA. Conventional diagnostic procedures of RA are based on examination of the patient, biochemical tests, including serum RF and anti-CCP antibodies, and radiography. Computerization of these indexation methods can make them faster and more accurate with the help of AI and increase disease prognosis.

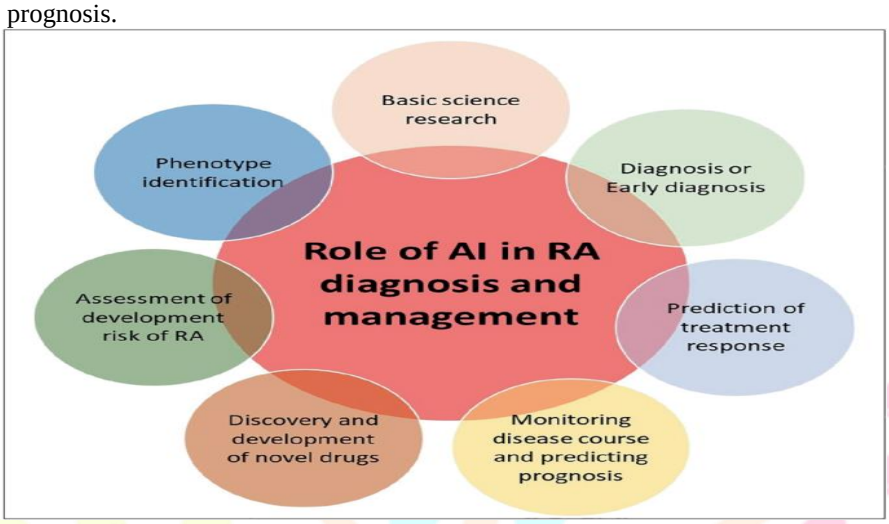

Figure 3: Role of AI in diagnosis and management of RA

Predictive Models

It is the ml models used that can be used to analyze patient data to determine the possible onset of RA among high-risk individuals. These can result to early detections and treatments thus being able to reduce the rate at which the diseases progress, not forgetting the quality of life in patient is enhanced.

Automated Image Analysis

CNNs have the ability to study x-rays and MRI scans of the joint for initial symptoms of RA including bone erosion, and synovitis. Automated systems offer clear and didactic results through different human readers, avoiding high variations.

Remote Monitoring

Applications with AI that synchronize with the cloud platforms can track patients through wearable gadgets. This device records the mobility and pain, flexibility of the joints of the patients and this leads to monitoring of the diseases on the daily basis and hence proper intervention. [22]

2.4.4 Active drug screening for Rheumatoid arthritis

The major methodology that is applied in compound library screening is referred to as **High-Throughput Screening (HTS)**

HTS is a strong technology which is applied to screen thousands of chemical compounds for their possible therapeutic activities. In the RA studies, HTS can be used on the library of natural products for the identification of bioactive compounds TCM included. They can then be subjected to additional studies on the properties of anti inflammation, immunodulation, or joint preservation.

Cell-Based Assays: Synovial fibroblast or immune cells or chondrocytes isolated from RA patients are cultured in vitro to assess the anti inflammatory properties of compounds and to check for the ability of these compounds to protect the cartilage matrix.

Molecular Target Screening: This includes testing on chemical agents that binds to particular proteins implicated in RA, for instance cytokines including TNF- α, IL-1 β, enzymes including MMPs or relevant signaling networks including JAK/STAT. [22]

Network pharmacology approaches

It is possible analyze goal interactions and study activities of chemicals. Since most TCM preparations have multiple components it is difficult to determined exactly how each works in its therapeutic effect. Network pharmacology combines systems biology approaches, information technology, and polypharmacology to predict the molecular target profiles of TCM compounds and evaluate the modulation of RA associated molecular networks. This way can make the researchers predict which parts of TCM contribute to their therapeutic benefits for RA even before clinical testing. [23]

2.4.5 Elucidation of the Pharmacological Effects of TCM in RA

TNF-alpha is a pro-inflammatory cytokine, closely related to the RA pathology and there is evidence that many TCM herbs and herbs mixtures have TNF–alpha inhibitory properties. For instance Curcumin derived from Curcuma longa. We have seen that Curcumin is effective in inhibiting the activity of COX-2 and the formation of Reactive oxygen species thus decreasing inflammation and destructive changes in RA affected joints. TCMs can modulate immune system function, which is critical in controlling the autoimmune aspects of RA. Glycyrrhizin: An isolated compound of the plant Glycyrrhiza uralensis or glycyrrhizin affects T cell action beneficially for RA and has been reported to suppress the proliferation of synovial fibroblast. RA results in the continuous erosion of cartilage and bone, and thus joint tissue

preservation could be a potential healing strategy, here TCM compounds have been examined. This is because the active compound namely icariin present in this herb has been proven to stimulate cartilage regeneration process with the help of stimulation of chondrocyte proliferation besides suppression of the cartilage degradation enzymes known as matrix metalloproteinase's (MMPs). [23]

2.4.6 Evaluation of the Effectiveness of TCM in Rheumatoid Arthritis

A critical review of preclinical and clinical study for utilization of TCM in management of RA also implies that studies supporting clinical utility of TCM must provide sufficient evidence.

Preclinical Studies

In the context of RA, CIA and AIA models are widely employed as procedures to assess experimental TCM compounds. These models make it possible for the researchers to observe the extent to which TCM can help bring down joint inflammation, and the bone erosion. Astragalus membranaceus for counter current experiments, CIA models have documented how extracts from the "Astragalus" lessen the intensity in joint inflammation and prevent disease progression due to immunomodulatory and antioxidant properties. [24]

Clinical Trials

For evaluating the efficacy of TCM in RA patients, only randomized control trials (RCTs) are reliable. Several clinical trials have examined the TCM formulations independently and as add-ons to the conventional treatment.TCM Formulations Several human TCM herbal formulations have been examined in clinical research practice; studies have demonstrated the potential of increasing joint mobility and decreasing pain in RA patients. Although more clinical research are required to validate such results.

2.4.7 Challenges and ethical Consideration

Data Privacy and Security: Storing patients' information in the cloud poses questions about security breaches and legal requirements such as HIPAA and GDPR.

Interpretability: Some deep learning models work as 'black boxes' thus failing to provide clinicians with rationale for specific choices made. The importance of greater transparency on the models that underpin AI applications cannot be overemphasized to encourage greater reliance on such applications. [25]

2.5 Liver Injury

Hepatoprotective effect on liver injury: Penthorum Chinese Pursh, a TCM plant, which has been focusing on researching this class drug. A few investigations have investigated its MOA particularly the AI-assisted approaches like, network pharmacology, molecular docking and machine learning models. AI techniques assist in capturing the crosstalk between bioactive compounds of Penthorum Chinese and biological networks relevant for addressing liver injury. [26]

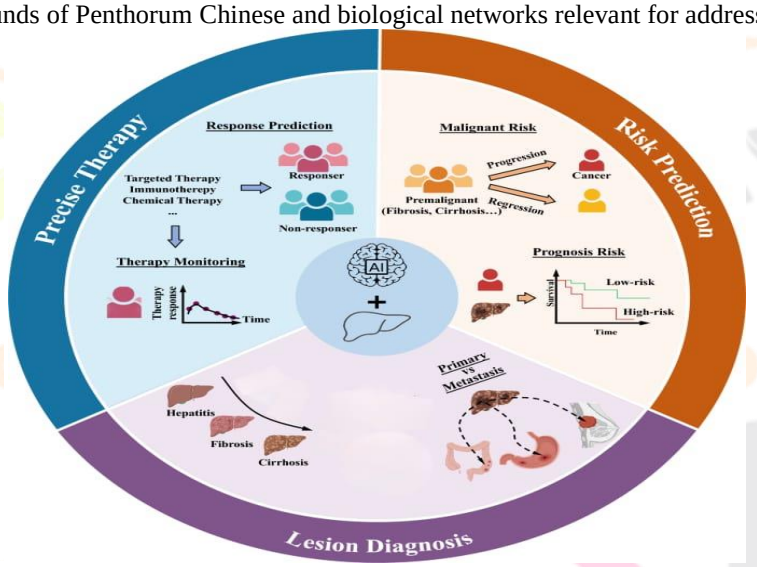

Figure 4: Artificial Intelligence in Liver imaging

2.5.1 Network Pharmacology

This strategy is useful for determining the bioactive constituents of Penthorum chinense and even estimating likely target proteins involved in preserving liver functions. With the inclusion of this feature, the interconnection between several compounds and other target genes as well as various biological pathways can be solved.

2.5.2 Molecular Docking

AI models mimic binding between active compounds of Penthorum Chinese, like flavonoids and liver enzymes or protein relevant to inflammation, fibrosis, or oxidative stress. Such interactions imply as to which of the pathways might be altered to maintain the liver health. [27]

2.5.3 Machine Learning Models

AI can be applied for processing data from clinical trials, biochemical tests and genomic patterns for the estimation of the efficiency of Penthorum Chinese in liver injury. When models learned from biomarkers of liver injury and treatments, AI can determine how such bioactive compounds within the plant impact certain types of liver ailment. Example of AI-Assisted Research Findings: A molecular docking study employing AI based network pharmacology proposed that the bioactive components of Penthorum Chinese could influence active liver damage pathways such as TNF-α and TGF- β that has functions in inflammation and fibrosis. Machine learning analysis of hepatotoxicity datasets demonstrated that the therapeutic application of Penthorum Chinese would alleviate preclinical experimental oxidative stress and liver fibrosis. [28]

2.5.4 Challenges

Network Analysis Limitations: Literature review or the study of peer reviewed articles or a report of traditional medicine tends to be initial and may therefore produce inconclusive results. Some compounds like polyphenols may be act

as interferon's that will cause certain analysis to give positive results which are not true.

Data and Model Dependency: AI technology depends on high quality data input and algorithms as the key factors that determine its utility. The stability and ability of these models to generalize may be insufficient. [29]

2.6 Acute Respiratory Distress Syndrome (ARDS)

The Ning Fei Ping Xue decoction, which is a traditional Chinese medicine, has the possibility in treatment of ARDS and the regulation on immune-inflammatory response. While there are no many studies applying AI directly to linking Ning Fei Ping Xue to ARDS and immune modulation, there are many studies using AI in this field. Applying AI models such as in bioinformatics can help in decoding molecular mechanisms, identifying possible treatment signing and even immunization of traditional medicine on the immune reactions level.

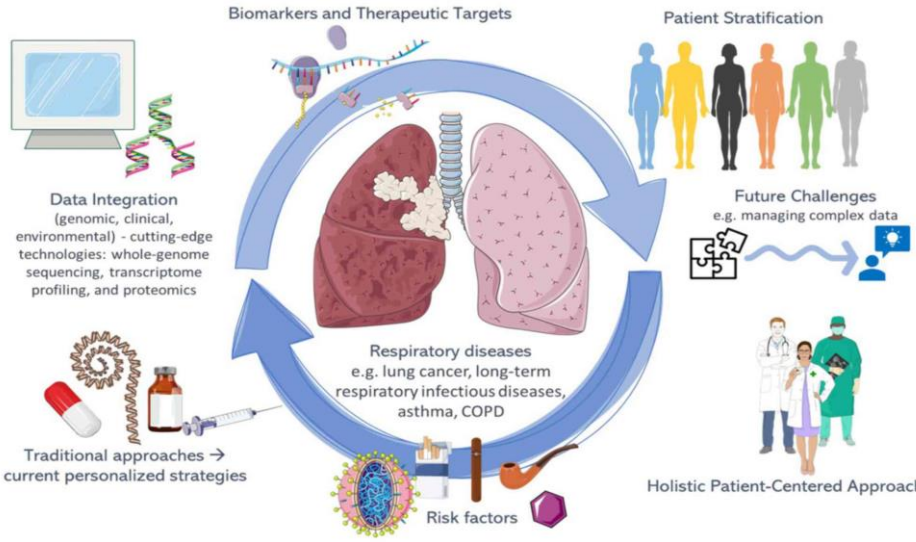

Figure 5: AI in Acute respiratory distress syndrome

2.6.1 Mechanism of Ning Fei Ping Xue Decoction in ARDS

Ning Fei Ping Xue decoction consist of herbs employed for the Chinese material medical purpose of tonifying lung and invigorating blood circulation. The herbs most commonly used in this formula are, to name a few, beneficial in reducing inflammation in the lung tissue something that could potentially help with some of the ARDS symptoms. These help against oxidative stress a major consideration in exacerbating lung tissue injury in ARDS. Thus, the decoction may inhibit overenthusiastic immune response, which is pathogenic in disorders such as ARDS. Investigations have shown that these herbs have anti-inflammatory, antioxidant and immune modulatory effect which could be useful in ARDS. The exact molecular effect is still under research but according to existing research involves cytokine modulation, inhibition of NF-kB and reduction of oxidative stress. [30]

2.6.2 AI in Traditional Chinese Medicine and Immune Modulation

In the last decade, the field of AI has offered methods of machine learning and data mining to estimate the pharmacological outcomes of herbal drugs. With the help of AI, pharmacotherapy, genomics, and patient records to train machine learning models to predict active compounds of Ning Fei Ping Xue decoction and its effects on immune regulation. [30]

2.6.3 AI approaches include

TCM is multimodal and interactional; they prefer AI-based methods to explain them. Another shared benefit of using AI, is its capability to synthesis information derived from pharmacology, genomics, and clinical records for enhancing understanding of the efficacy of TCM and its mode of action at the molecule level. Here's how different AI methodologies are applied:

Molecular Docking

This approach employs the use of artificial intelligence in anticipating the compatibility and functionality of active compounds in Ning Fei Ping Xue to molecular targets linked to ARDS: These include pro-inflammatory cytokines such as TNF-α, IL-6 and IL -1β, which trigger inflammation in ARDS

Gene Expression Profiling

Through analyzing results of gene expression and employing the methods of machine learning, it is possible to show that Ning Fei Ping Xue decoction changes inflammatory and immune response gene expression level. This offers clues to how the formula might change immune cell function or tilt cytokine secretion to reveal its immune function.

Network Pharmacology

Given the immunopathogenesis of ARDS, network pharmacology is beneficial in morphologically modeling interactions between the multiple constitutional compounds in the decoction with the network of proteins underlying inflammation and immune response. This helps make conclusions as to which of the active substances found in the herbs and other components, are likely to be responsible for certain therapeutic effects. [31]

Clinical Data Mining

With regards to the real-word application of Ning Fei Ping Xue decoction, it is evident that large scale clinical data could be evaluated for determining the effectiveness of this intervention on respiratory ailments; the proportion of patient recovery rates, increased inflammatory markers and patients' self-reported data, among others. [31]

2.6.4 Potential Therapeutic Effects of Ning Fei Ping Xue Decoction in ARDS

The traditional AI model has been used to find out that Ning Fei Ping Xue can potentially block several inflammatory mediators that lead to lung inflammation consequently, this decoction may arrest immune over-activation and prevent

poisonous effects of the immune system in ARDS patients on the lungs. Through the use of artificial intelligence in analyzing the compounds present in the decoction, it has shown that the decoction has been determined to have anti-oxidant compounds that can help counter what ARDS patients are exposed to known as oxidative stress. Subsequent studies should aim at using AI to combine laboratory and clinical settings to further validate this TCM formulation in ARDS intervention. [32]

2.6.5 Challenges of an AI and TCM Based Approach for ARDS

Complexity of Herbal Formulas: Accordingly, the present traditional prescriptions such as Ning Fei Ping Xue decoction include a number of efficacy ingredients that have various combines' effect. These interactions are often multivariate and non-linear, and naturally occur within biological systems, in which AI models may have a hard time modelling appropriately. Also routinely, it is challenging to identify the main bioactive ingredients of a formula owing to the combined actions of various herbs. [33]

Ethical and Regulatory Hurdles: Considering applying AI to TCM for ARDS treatment, there are the issues related to regulations and safety because clinical trials are obligatory. For this reason, it is necessary to have large, safe for subjects trials on TCM compounds-validation of the AI predictions on people can also be a challenge. [34]

3. Conclusion

In conclusion, artificial intelligence (AI) in traditional medicine research and practice is the revolution. AI simplifies a researcher's work by allowing them to go through large volumes of data to come up with better therapeutic treatment plans. Moreover, the role of artificial intelligence in drug discovery and the improvement of the application of such machines in the management of patients are highlighted.

However, some concerns are present proper validation of AI methodologies and approaches, and the possibility to retain cultural and contextual characteristics of traditional methods. AI developer and the traditional medicine practitioners must work hand in hand to ensure the innovations meet the society scientific findings and cultural practice. In the end, there is massive potential for uniting the known benefits of AI with traditional medicine in its further development to enhance the general impact on the existence of humanity while appreciating the traditional knowledge, on the one hand, and adopting advanced technological approaches on the other.

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